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(71) Applicant
Powered Showers Plc

(Incorporated in the United Kingdom)

4 Parkside, Ringwood, Hampshire, BH24 3SQ, United Kingdom

(72) Inventor
Colin McMaster-Christie

(74) Agent and/or Address for Service
Marks & Clerk
Alpha Tower, Suffolk Street Queensway, Birmingham, B1 1TT, United Kingdom

(54) Flow switch assembly

(57) A flow switch assembly has a body with a passage 11. A flap 14 is pivotally mounted at 15 in a recess 12 in the body and, in one position, obscures the passage 11. The flap 14 carries a magnet 16 which acts on a reed switch 17 disposed externally of the passage 11. A fixed magnet 19 is disposed adjacent the reed switch 17. The magnets 16 and 19 act on the reeds of the reed switch so that, in said one position of the flap, the magnetic forces generated augment each other to maintain the reed switch closed, whilst upon movement of the flap 14 out of said one position, the magnetic forces causes a repulsion between the reeds, thereby leading to improved response with low hysteresis.

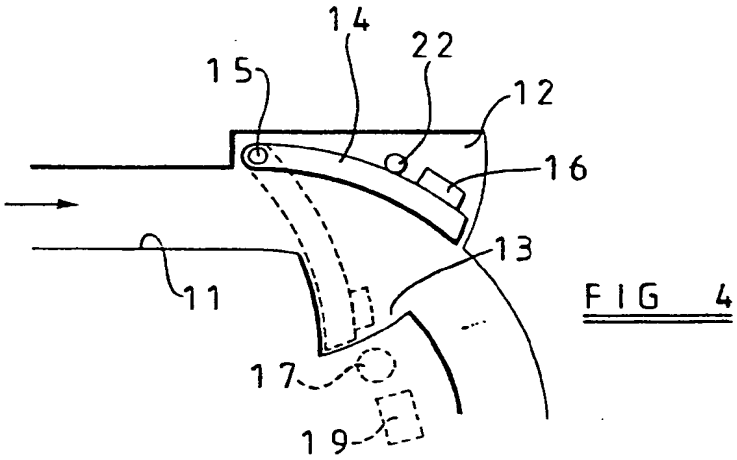

FIG 4

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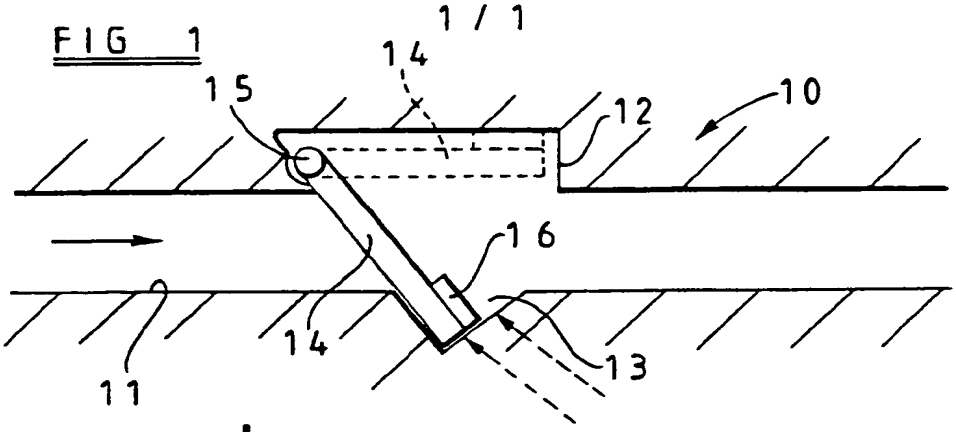
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG 1



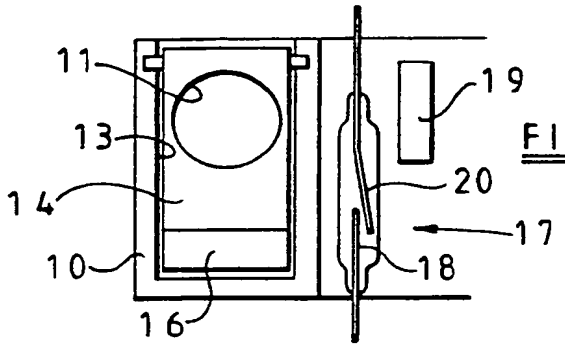


FIG 2

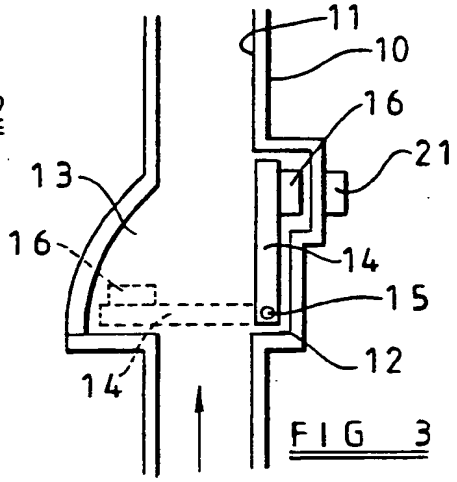


FIG 3

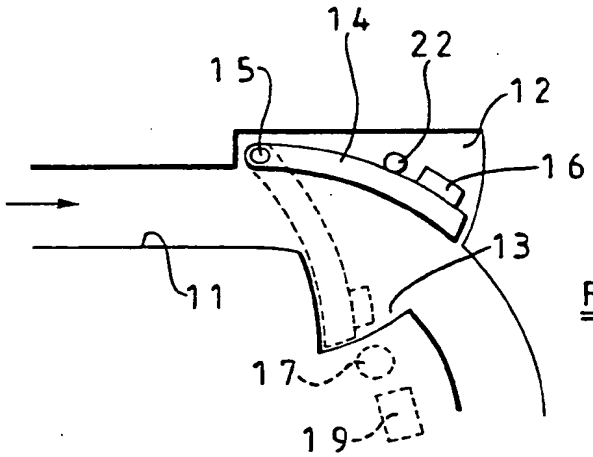


FIG 4

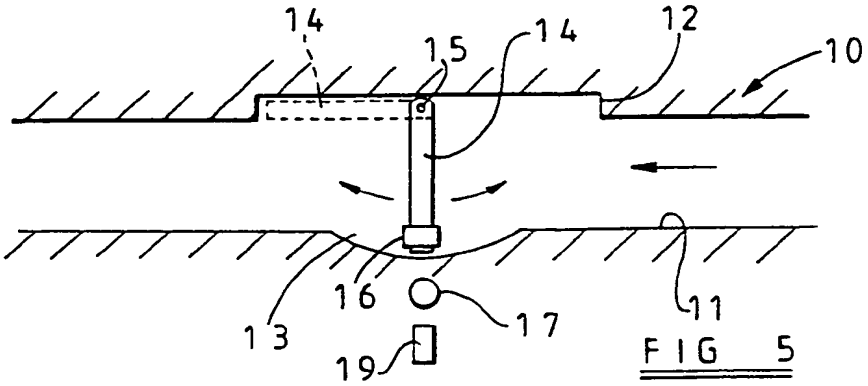


FIG 5

FLOW SWITCH ASSEMBLY

This invention relates to a flow switch assembly and is more particularly, but not exclusively, concerned with an electrical switch assembly for sensing flow in a conduit, eg for use in a pumped shower system where manual operation of a control knob causes flow of water through a conduit and operation of the flow switch energizes a pump for increasing the rate of flow of water to a shower head. The invention is also concerned with a magnetically operable switch assembly, eg a reed switch.

Magnetically operable reed switches are known per se wherein a ferromagnetic reed is acted upon by a pair of magnets. One magnet is a relatively fixed magnet which is positioned adjacent the reed switch so as to act thereon to close the switch. However, when a second magnet is brought into the proximity of the reed switch with its poles orientated so as to counteract the effect of the first magnet, the inherent biasing of the reed causes it to move to an open position. Whilst such an arrangement can be more sensitive than a single magnet operated reed switch, it is still not particularly sensitive and still suffers from a degree of hysteresis.

It is an object of one aspect of the present invention to enable the above disadvantage to be obviated or mitigated.

According to said one aspect of the present invention, there is provided a magnetically operable switch assembly comprising first and second electrical contacts mounted for relative movement between an open position and a closed position, first and second ferromagnetic means associated with the first and second contacts respectively, a first magnet positioned adjacent said ferromagnetic means with one of its poles closer to the first ferromagnetic means than the other of its poles so as to induce a magnetic

field in the first ferromagnetic means which, in turn, induces a magnetic field in the second ferromagnetic means thereby tending to close the contacts, and a second magnet mounted for movement relative to the second ferromagnetic means so that, in one position of movement, the magnetic field induced in the second ferromagnetic means augments that induced therein by the first magnet thereby increasing the attractive force between the ferromagnetic means and maintaining the electrical contacts in the closed position, whilst in another position of the second magnet, the magnetic field induced in the second ferromagnetic means reverses the magnetic field induced therein by the first magnet, whereby a repulsion between the first and second ferromagnetic means causes the contacts to be moved into the open position.

By relying on positive magnetic attraction and positive magnetic repulsion in the two positions of the second magnet, a positive action is obtained which can lead to an improved response with low hysteresis.

Whilst the ferromagnetic means may be constituted by the material of construction of the contacts themselves, such materials do not generally possess the properties required of electrical contacts and so it is preferred to form at least the contact surfaces of the contacts out of the suitable contact material (eg silver, nickel, gold or platinum).

The switch assembly preferably takes the form of a reed switch, although it may operate on the principle of the Hall effect.

Preferably also, the second magnet takes the form of a plate whose edge is presented towards the second ferromagnetic means and which is magnetized so that the poles exist on opposite major surfaces of the plate. The

relatively short distance between the surfaces of the plate ensures that there is only a very short distance between the said one position and the said another position of the second magnet, whereby the switch changes its condition promptly after only a short movement of the second magnet.

According to a second aspect of the present invention, there is provided a flow switch assembly comprising a body having a passage therein through which, in use, fluid whose flow is to be sensed passes, a flap pivotally mounted in the body and moveable when acted upon by flow of fluid from a first position in which it substantially obscures the passage in the body into a second position in which it permits flow of fluid through the passage, a magnet mounted on the flap, and a magnetically operable switch disposed externally of the passage and adjacent said magnet so as to be acted upon by said magnet, whereby movement of the flap out of its first position by flow of fluid through the passage causes the magnetically operable electrical switch to change its switched state.

The magnetically operable electrical switch is preferably a switch according to said first aspect of the present invention, wherein said second magnet is mounted on the flap.

In a particularly convenient arrangement, a recess is provided in a side wall of the passage and the flap is pivotally mounted so that, in its second position, the flap is disposed substantially completely within said recess so that the restriction to flow is minimised in the region of the flap.

Preferably, a further recess is provided on the opposite side of the passage to the first-mentioned recess, and receives the pivot-remote end of the flap when the latter

is in its first position. Most preferably, the magnetically operable switch and the magnet are so disposed relative to one another that the switch is caused to change its state before the pivot-remote end of the flap has moved out of said further recess when moving from its first position.

In a first embodiment, the passage in the body is substantially horizontally disposed in use and the first-mentioned recess is disposed above the second mentioned recess so that the action of gravity causes the flap to move into its first position.

In a second embodiment, the passage in the body is upright and upward movement of fluid in the passage causes the flap to be moved from its first position to its second position where it extends substantially vertically upwardly. To avoid the risk of the flap being retained in its open position, it is preferred to provide biasing means for urging the flap out of its vertical position so that it can then drop into its first position. Conveniently, the biasing means takes the form of a resilient element such as a spring. Alternatively, it may take the form of a further magnet which is disposed adjacent said first recess with its poles arranged so that it repels the magnet mounted on the flap.

In a third embodiment, the passage is curved and the flap is likewise curved so that, when the flap is in its second position, one surface of the flap adopts the curvature of the passage to minimise the restriction to flow of fluid around the curve in the passage.

In a fourth embodiment, the passage in the body is substantially horizontally disposed, the flap is pivotally mounted at the top of the passage so that it hangs downwardly across the passage in its first position and is

movable in either direction out of its first position, and the magnetically operable switch is positioned so that it changes its switched state upon movement of the flap in either direction out of said first position. Thus, the flow switch assembly can operate irrespective of the direction of flow of fluid through the passage. As a result, the flow switch assembly can be installed in pipework either way around.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic side view of a flow switch assembly according to a first example of the present invention,

Figure 2 is a schematic section through the flow switch assembly of Figure 1,

Figure 3 is a schematic side view of a modified form of flow switch assembly according to a second example of the present invention,

Figure 4 is a schematic side view of a further modified form of flow switch assembly according to a third embodiment of the present invention, and

Figure 5 is a schematic side view of a still further modified switch assembly.

Referring now to Figures 1 and 2 of the drawings, the switch comprises a body 10 having a passage 11 which extends therethrough. In this embodiment, the switch 10 is intended to be used with the passage 11 disposed horizontally as illustrated in Figures 1 and 2. The body 10 has a first recess 12 therein which is of generally rectangular shape in plan view, and a second recess 13

lying on the opposite side of the passage 11 to the first recess 12. A rectangular flap 14 is pivotally mounted at its top end in the first recess 12 by means of a pivot pin 15. The pivot pin 15 is horizontally disposed to extend transversely with respect to the passage 11 at the upstream end of the first recess 12 relative to the intended direction of flow of water through the passage 11 in use. The pivot pin 15 is also disposed upstream of the second recess 13. The flap 14 therefore tends to be urged by gravity downwardly so that its free end is disposed within the second recess 13 whereby it completely obscures the passage 11. At its lower end, ie the free end remote from pivot pin 15, the flap 14 has a magnet 16 secured thereto. The magnet 16 is disposed on the downstream face of the flap 14 and is substantially completely accommodated within the second recess 13 when the flap 14 is in the position shown in Figure 1.

The magnet 16 takes the shape of a plate which is magnetized so that the north and south poles are on the opposite major surfaces of the plate.

Disposed externally of the passage 11 and laterally adjacent to the second recess 13 is a magnetic reed switch 17. One of the reeds 18 of the switch 17 is disposed sufficiently close to the magnet 16 when the flap 14 is in the position illustrated in Figure 1 that it is inductively connected therewith in a magnetic sense. Another magnet 19 is disposed sufficiently close to the other reed 20 that it is inductively connected therewith in a magnetic sense. The polarities of the magnets 16 and 19 are chosen so that the upper major surface of the magnet 16 as viewed in Figure 1 has the same polarity as the pole of the magnet 19 which is the closest to the reed 20. This causes induction of mutually repulsive magnetic fields in the reeds 18 and 20.

Thus, the switch 17 is maintained in an open position as illustrated in Figure 2 when the flap 14 is in the position illustrated in Figure 1.

As soon as water starts to flow through passage 11 upon manual operation of a control valve, the pressure flap 14 causes it to pivot upwardly as viewed in Figure 1 so that the latter ultimately adopts the position illustrated in dotted line in Figure 1. In such dotted line position, the flap 14 and the magnet 16 are received wholly within the recess 12, thus leaving a completely unimpeded cross section for flow of water through the passage 11. However, before even the pivot-remote end of the flap 14 has left the recess 13, it has moved the magnet 16 sufficiently far that the lower major surface of the latter, ie that surface which abuts against the flap 14 to lie closer to the reed 18 than the opposite or upper major surface of the magnet 16. The amount of movement of the flap 14 required to effect this is illustrated by the distance between the two dotted line arrows at the bottom of Figure 1. Thus, it will be appreciated that the magnetic pole which exerts its effect on the reed 18 has changed to that which is of opposite polarity to the pole of the magnet 19 effectively acting on the reed 20. The net result of this is that the reeds 18 and 20 are strongly attracted together, thus closing the switch 17 without delay.

In this particular embodiment, the switch 17 is connected in a power supply to a pump which pumps water to a shower head (not shown). Thus, the flow rate of water through the passage 11 is substantially increased when the pump starts to operate and the flap 14 is quickly moved into its dotted line position in use.

The flow of water is cut off by operating the above-mentioned manual control valve. Once the flow of water through passage 11 has stopped, the flap 14 quickly drops

under the action of gravity back into the position illustrated in full line in Figure 1 so that the reeds 18 and 20 are opened, thereby de-energising the pump.

In the example illustrated in Figure 3, the mode of operation is much the same and similar parts are accorded the same reference numerals. However, in this embodiment, the body 10 is designed to be disposed in use with the passage 11 extending vertically. Because of this difference, a further magnet 21 is provided outside the first recess 12 with a pole arranged to repel magnet 16. This repulsion ensures that the flap 14 is pushed out of its vertical position when flow of water through passage 11 is stopped so that gravity can take over and move the flap 14 into its lowered position (as illustrated in dotted line in Figure 3).

In the third example illustrated in Figure 4, the passage 11 is curved and the flap 14 itself is also curved so as to conform to the curvature of the passage 11 when received within the recess 12. A stop 22 is provided in the recess 12 for limiting upward movement of the flap 14.

In a modification (shown in dotted line in Figure 4), the reed switch 17 is positioned under magnet 16 when the flap 14 is in its lowered position and the fixed magnet 19 is so disposed and orientated relative to the magnet 16 that it exerts a repulsion force thereon in the opening direction of the flap. This repulsion force is not sufficient to open the flap, but reduces the force required to move it when it is acted upon by water pressure, thereby enhancing the sensitivity of the switch.

Referring now to Figure 5, the mode of operation of the flow switch assembly is similar to that described above and similar parts are accorded the same reference numerals. In this embodiment, the flow switch is sensitive to flow of

water along the passage in either direction. If water flows from right to left along the passage as shown in Figure 5, the flap 14 will be pushed leftwards away from its vertical position, in which the switch was in one state, towards the left hand portion of the upper recess 12. Before the movable magnet 16 attached to the flap 14 has left the recess 13 in the bottom of the passage 11, the polarity of the magnetic field acting on the contact associated with the movable magnet 16 of the reed switch will change. As the polarity of the magnetic field acting on the other contact is constant, the force between the contacts will reverse in direction, ie if previously there was a repulsive force between the contacts, it is now an attractive force, and vice versa, hence the state of the switch will have changed.

If the water in the passage flows from the left to right, the flap will move towards the right hand portion of the upper recess 12. Again, due to the construction of the movable magnet 16, the field acting on the contact associated with the movable magnet will change causing a change of state of the switch as above.

In either case, upon termination of the flow of water, the flap will return to its vertical position under the action of gravity. This will again cause a reversal of the field acting on the contact associated with the movable magnet causing the switch to change back to its original state.

The flow switch assembly of Figure 5 has the advantage that it will work irrespective of which way around it is fitted in a flow passage in which flow of fluid is to be sensed.

CLAIMS

1. A magnetically operable switch assembly comprising first and second electrical contacts mounted for relative movement between an open position and a closed position, first and second ferromagnetic means associated with the first and second contacts respectively, a first magnet positioned adjacent said ferromagnetic means with one of its poles closer to the first ferromagnetic means than the other of its poles so as to induce a magnetic field in the first ferromagnetic means which, in turn, induces a magnetic field in the second ferromagnetic means thereby tending to close the contacts, and a second magnet mounted for movement relative to the second ferromagnetic means so that, in one position of movement, the magnetic field induced in the second ferromagnetic means augments that induced therein by the first magnet thereby increasing the attractive force between the ferromagnetic means and maintaining the electrical contacts in the closed position, whilst in another position of the second magnet, the magnetic field induced in the second ferromagnetic means reverses the magnetic field induced therein by the first magnet, whereby a repulsion between the first and second ferromagnetic means causes the contacts to be moved into the open position.

2. An assembly as claimed in claim 1, wherein the second magnet takes the form of a plate whose edge is presented towards the second ferromagnetic means and which is magnetized so that the poles exist on opposite major surfaces of the plate.

3. A flow switch assembly comprising a body having a passage therein through which, in use, fluid whose flow is to be sensed passes, a flap pivotally mounted in the body

and movable when acted upon by flow of fluid from a first position in which it substantially obscures the passage in the body into a second position in which it permits flow of fluid through the passage, a magnet mounted on the flap, and a magnetically operable switch disposed externally of the passage and adjacent said magnet so as to be acted upon by said magnet, whereby movement of the flap out of its first position by flow of fluid through the passage causes the magnetically operable electrical switch to change its switched state.

4. An assembly as claimed in claim 3, wherein the magnetically operable electrical switch is an assembly as claimed in claim 1, and wherein said second magnet is mounted on the flap.

5. An assembly as claimed in claim 3 or 4, wherein a recess is provided in a side wall of the passage and the flap is pivotally mounted so that, in its second position, the flap is disposed substantially completely within said recess so that the restriction to flow is minimised in the region of the flap.

6. An assembly as claimed in claim 5, wherein a further recess is provided on the opposite side of the passage to the first-mentioned recess, and receives the pivot-remote end of the flap when the latter is in its first position.

7. An assembly as claimed in claim 6, wherein the magnetically operable switch and the magnet are so disposed relative to one another that the switch is caused to change its state before the pivot-remote end of the flap has moved out of said further recess when moving from its first position.

8. An assembly as claimed in claim 6, wherein the passage in the body is substantially horizontally disposed

in use and the first-mentioned recess is disposed above the second mentioned recess so that the action of gravity causes the flap to move into its first position.

9. An assembly as claimed in any one of claims 3 to 7, wherein the passage in the body is upright and upward movement of fluid in the passage causes the flap to be moved from its first position to its second position where it extends substantially vertically upwardly.

10. An assembly as claimed in claim 9, including biasing means for urging the flap out of its vertical position so that it can then drop into its first position.

11. An assembly as claimed in any one of claims 3 to 7, wherein the passage is curved and the flap is likewise curved so that, when the flap is in its second position, one surface of the flap adopts the curvature of the passage to minimise the restriction to flow of fluid around the curve in the passage.

12. An assembly as claimed in any of claims 3 to 7, wherein the passage in the body is substantially horizontally disposed, the flap is pivotally mounted at the top of the passage so that it hangs downwardly across the passage in its first position and is movable in either direction out of its first position, and the magnetically operable switch is positioned so that it changes its switched state upon movement of the flap in either direction out of said first position.

13. A magnetically operable switch assembly as claimed in claim 1, substantialy as hereinbefore described with reference to Figs 1 and 2, or Fig 3, or Fig 4, or Fig 5 of the accompanying drawings.

14. A flow control switch assembly as claimed in claim

3, substantialy as hereinbefore described with reference to Figs 1 and 2, or Fig 3, or Fig 4, or Fig 5 of the accompanying drawings.

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